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ABSTRACT

Because the pressure of technological advancement has made teaching factual knowledge increasingly difficult, educators have been developing curriculums to transmit intellectual processes applicable to many tasks instead of subject matter content. One of the 20 educational Follow Through programs, the Tucson Early Education Model, surveyed 42 TEEM-trained teachers (EP) and 75 non-TEEM teachers in Iowa, Texas, Georgia, and Louisiana to determine if teachers ask questions which elicit intellectual operations in children. Teachers were audio taped for 40 minutes in classrooms. Their questions were classified according to an Intellectual Operations model based on Guilford's Structure of the Intellect. The six classifications were (1) perception, (2) cognition, (3) memory, (4) divergent production, (5) convergent production, and (6) evaluation. Analysis of data revealed that EP and NP teachers differed in teaching style. Although both groups placed inordinate stress on knowledge and memory questions which precluded the opportunity to teach other intellectual operations, EP teachers exhibited a significant shift away from this practice. The TEEM process approach attempts to prevent the teacher's imposition of intellectual demands for skills not present in the child's repertoire and capitalizes on the motivation inherent in his success. This new emphasis may have great impact, especially when employed to teach disadvantaged children. (MH)

INTELLECTUAL OPERATIONS IN TEACHER-CHILD INTERACTION*

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The pressure of recent technological advancement has made the selection and teaching of relevant factual knowledge an increasingly difficult task. This situation has prompted educators and psychologists to move toward the development of curricula designed to transmit intellectual processes applicable to a wide variety of tasks instead of subject matter content (vide Bruner, 1966; Wallach & Kogan, 1965; Henderson, Hughes, & Wetzel, 1968).

One educational model emphasizing the development of intellectual processes in elementary school youngsters is the Tucson Early Education Model (TEEM). The TEEM is an experimental educational program with the objectives of enabling children to achieve necessary language competence, intellectual competence, motivation, and societal arts and skills to function as effective adults in a changing society. Implementation of the TEEM is based on a system of educational services composed of three components: (1) classroom instructional staff: teacher aides, teachers, program assistants (trainers of teachers); (2) parent coordinators who work as organizers, developers, and implementers of significant parent involvement;

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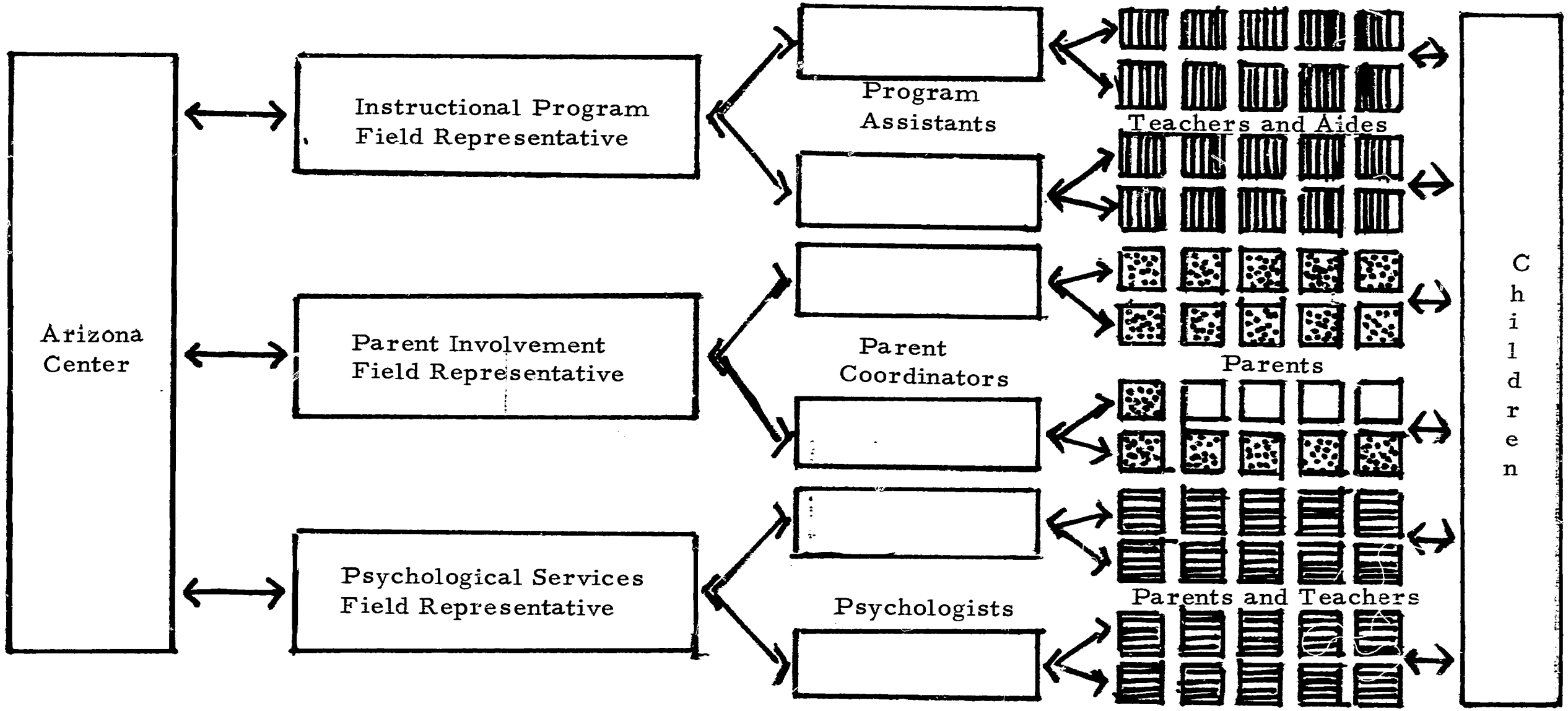

Fig. 1 The TEEM System of Educational Services

(3) school psychologists who serve as consultants to instructional personnel and parents concerning learning and adjustment in children. Figure 1 presents a schematic diagram of the TEEM system of educational services.

Insert Figure 1 about here

The TEEM is one of twenty educational models in the national Follow Through Program. Follow Through is a federal effort to develop adequate means for meeting the educational needs of disadvantaged children in kindergarten through the third grade.

Although there has been increased interest in the development of intellectual skills in children as evidenced by the extensive experimental literature dealing with intellectual processes in the child and the establishment of "process" curricula like that of the TEEM, little is known about teacher behaviors designed to elicit intellectual operations in children. The present study focuses on teacher question asking behaviors as a means for initiating intellectual operations in students.

Questions are categorized in terms of an Intellectual Operations (IO) model based on Guilford's (1967) Structure of the Intellect. There are six categories in the IO model: perception, cognition, divergent production, convergent production, and evaluation.

The central hypothesis to be investigated in the present study is that in light of the long standing emphasis on content mastery in the nation's schools, teachers will tend to ask significantly more questions in the cognition category than in other intellectual operations categories. Findings in

Table 1

The Intellectual Operations Question Model

Category

1. Perceptual Questions - teacher interrogative statements concerning discriminable aspects of presented stimuli e.g., shape, color, size, etc. Example: What shapes are your name tags?
2. Cognition Questions - teacher interrogative statements about comprehension or knowledge. Example: What kind of pictures do you think I have?
3. Memory Questions - teacher interrogative statements asking for the recall of information which was received at an earlier point in time. Example: Where have you seen these before?
4. Divergent Production Questions - teacher interrogative statements asking for multiple student responses with regard to the presented stimulus. Example: What other ways can you put these together?
5. Convergent Production Questions - teacher interrogative statements asking for a single correct response from the child from a field of alternatives. It is often termed problem solving in that it requires intermediate steps between the presentation of the stimulus (problem) and the response (answer). Example: Do you think you can make a diamond out of these shapes?

Table 1

Continued

Category
6. Evaluation Questions - teacher interrogative statements asking for student responses concerning the extent to which information matches criteria. Example: Which picture is better?
7. Other Questions - teacher interrogative statements which are indistinct and/or cannot be discriminated according to the aforementioned categories. Directions phrased in an interrogative format would be classified in this category. Example: Would you like to take them out?

support of this hypothesis would raise the question of whether or not intellectual operations other than cognition, e.g., problem solving and creativity are being slighted in instruction.

A second general hypothesis is that training in a process curriculum (the TEEM) will alter teacher question asking behavior so that there will be less emphasis on the cognition category. Accordingly, it is hypothesized that when compared to non-program (NP) teachers, experimental program (EP) teachers will ask more perceptual questions, more divergent production questions, more convergent production questions and more evaluation questions. Since cognitive and memory questions were judged to be oriented toward a content mastery approach, EP teachers were expected to exhibit fewer such questions than their NP counterparts.

Table 1 presents operational definitions and examples of teacher questions characterizing each of the categories of the IO model.

Insert Table 1 about here

Subjects

Fourteen school districts from throughout the nation selected the TEEM Follow Through Program. From these districts, four were selected to participate in the present study. The four school districts were located in Des Moines, Iowa; Abbeville, Louisiana; Fort Worth, Texas, and LaFayette, Georgia. These school districts represent a variety of geographical areas of varying degrees of rural-urban character. From these districts,

42 EP and 75 NP teachers were selected to participate in the present study. The children of these teachers reflected a variety of socio-cultural groups: white-Anglo, Mexican-American, Black, Cajun, Oriental, and American Indian.

Procedures

The study was conducted approximately three months after the beginning of school. The local director for the Follow Through Project acted as primary liaison in the conduct of the present study. The director initially solicited the support of local school administrators for carrying out the study. Communities were selected by random procedures from the population of Follow Through communities using the TEEM. All Follow Through first grade teachers in the selected communities participated. Control NP teachers were also chosen from each community. The director identified the NP classrooms from poverty areas with a mean income of less than $5,000.

The director was asked to select an adult (preferably with test administration experience) to act as the data collection agent (DCA). Each selected teacher was audio taped for 40 minutes during normal classroom interaction. No standardized task was imposed during data collection. The DCA randomly assigned one half of the teachers in each city (both EP and NP teachers) to be taped during the morning and the remaining half to be taped during the afternoon.

Six research assistants were trained to use the IO model and served as coders of the obtained tapes. The coders worked in teams of two. One

Table 2

Analysis of Variance of Teacher Questions

Source of Variance	df	MS	F
Between Groups	1	.0004	
Error (G)	115	.0008	.534
Within Categories	6	21610.2378	170.788***
Group x Category	6	1141.8641	9.024***
Error (T)	690	126.5323	

***p < .001

Table 3

Means and t-ratios of EP and NP Teachers on Categories of IO Model

Categories	Hypotheses	NP Means	EP Means	df	t-ratios[1]
1	+	4.34	7.61	116	2.44*
2	-	37.21	26.66	116	3.77***
3	-	10.37	5.92	116	2.71**
4	+	.96	1.14	116	.56
5	+	14.20	16.08	116	.89
6	-	3.85	3.08	116	.65
7		29.08	39.50	116	3.31**

1 = reported significance is based on one-tailed probability estimates

* = p .05

** = p .01

**** = p .001

+ = positively hypothesized directionality

- = negatively hypothesized directionality

would operate the tape recorder by stopping the machine each time a question occurred. Each coder would independently categorize each question as it occurred into one of the seven categories of the IO model. At the end of each tape, total questions falling in each category were summed and these totals were ranked from one to seven for each coder. A reliability coefficient for each tape was computed on the ranks using the Spearman rho formula. The average reliability for 117 tapes was .96.

Results

The data were analyzed using a repeated measures analysis of variance design (Winer, 1962). The raw frequency data was converted to percentage for analysis purposes.

Insert Table 2 about here

Table 2 reveals that considering the EP and NP teachers together, the differences in frequency among the categories of the IO model were highly significant. Teachers in general do not distribute their questions evenly among categories. The highly significant interaction term indicates that EP teachers did significantly differ from NP teachers in one or more of the IO model categories.

To determine which categories of the IO model differentiated EP and NP teachers, *t*-tests were applied to EP and NP teacher mean percentages for each question category(Kirk, 1968).

Insert Table 3 about here

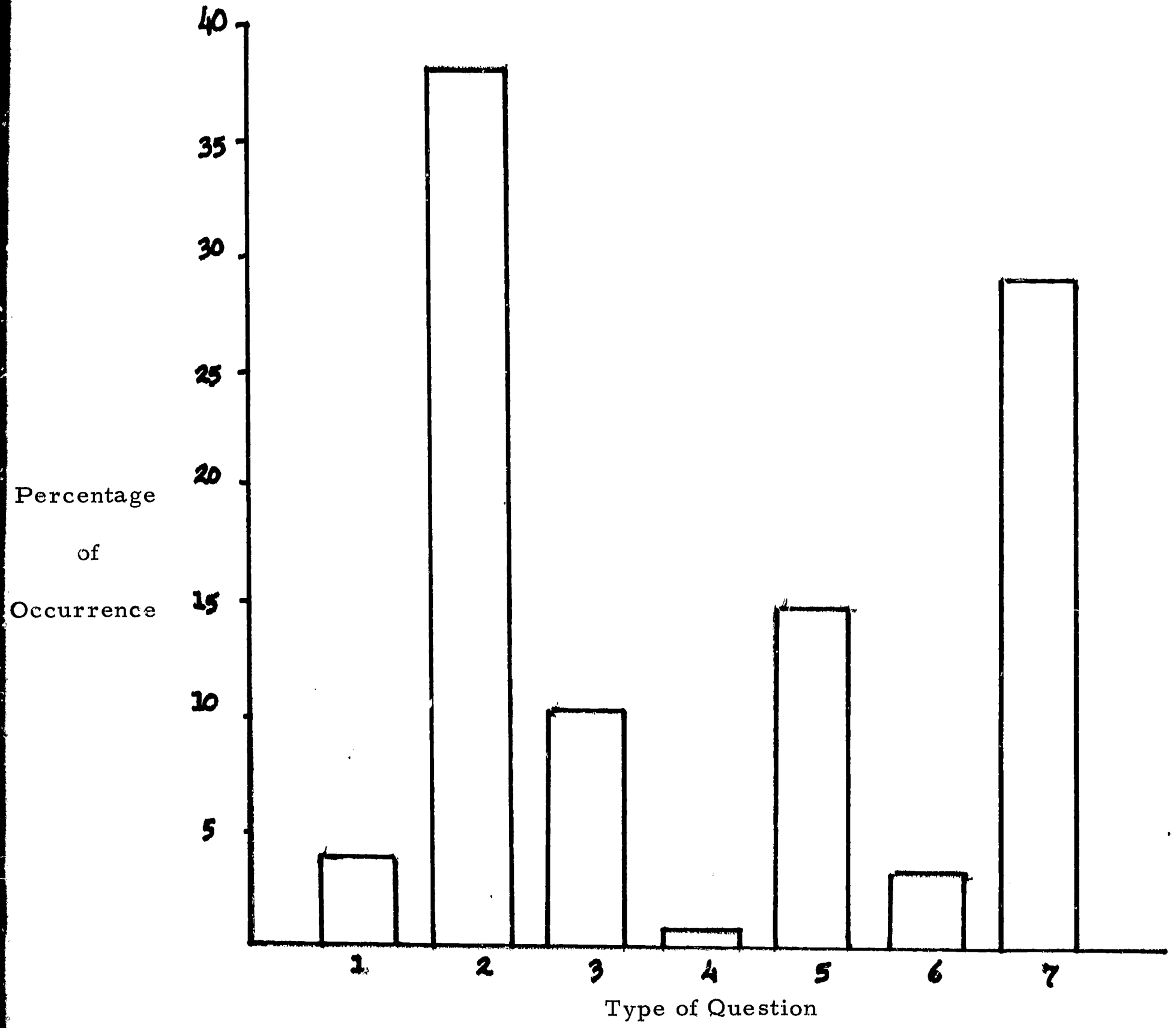

Fig. 2 Question Means for NP Teachers on the Intellectual Operations Mode

Table 3 indicates that EP teachers exhibited a significantly greater percentage of perceptual questions and "other" questions than NP teachers and a significantly smaller percentage of cognition and memory questions than their NP counterparts.

Perhaps the most interesting comparisons in the study dealt with the percentage of occurrance of each category in the IO model. As noted above, these differences among categories were highly significant. To achieve a representative profile of questioning patterns of teachers of disadvantaged children, the EP teachers were excluded from the analysis since they were the recipient of special training. Control teacher question profiles are presented graphically in Figure 2.

Insert Figure 2 about here

Inspection of Figure 2 reveals that the preponderance of teacher questions fell into two categories: Category two, cognition questions, comprised 37.2 percent of total teacher questions, and category six, other questions comprised 29.1 percent of total teacher questions. Category three, divergent production questions, accounted for 14.2 percent of teacher questions. Memory questions, category three, constituted 10.4 percent of total teacher questions. Only 4.3 percent of teacher questions required the child to make a perceptual response. Evaluation questions comprised only 3 percent of total questions, and convergent production or problem solving questions accounted for a mere one percent of teacher questions.

Discussion

The most striking finding to come out of the present study is the revelation of the inordinate amount of emphasis placed on factual knowledge questions in early education. Intellectual operations other than cognition which many educators and psychologists feel are vital to productivity in a changing society are not being stressed in teacher question asking behavior. The pervasiveness of this finding is demonstrated by the fact that it applies to children from different socio-cultural groups from different regions of the country.

Different motivational effects of the various types of questions in the IO model might be expected with disadvantaged children. The disadvantaged child lacks verbal skills (Loban, 1965; Frost & Hawkes, 1966), thus has much difficulty producing or retrieving verbally presented factual knowledge. It is an obviously debilitating situation when the child is confronted with extensive numbers of questions requiring responses clearly absent from the child's ability to perceive and process relevant stimuli through multiple modalities. The development of this capacity will afford the child greater awareness of the subtle sensory discriminations he can make to his environment. One product that would be expected from the process approach would be higher levels of student talk. There is evidence that this occurs in the interaction of EP teachers with disadvantaged children. Zimmerman (in press) found that EP teachers, most of whom were included in the present study sample, elicited significantly more child talk than did NP teachers. Thus the process approach attempts to prevent the teacher's imposition of

intellectual demands for skills not present in the child's repertoire and to capitalize on the motivation inherent in the child's success.

One important by-product of the present study is the establishment of the fact that a theoretical model based on factor analytic literature, such as the IO model, can be operationally defined in such a way as to reflect actual classroom behavior.

Future research efforts could concentrate on defining specific child behavioral outcomes resulting from exposure to various types and combinations of questions from the IO model, and thus provide the teacher with a feedback mechanism by which she can evaluate her success in teaching intellectual processes. In addition, such studies could investigate related environmental influences e.g., reinforcement, proping, and cueing to ascertain the optimal circumstances governing the child's acquisition of intellectual processes.

Summary

Teacher question asking behavior was investigated based on the intellectual operations required by the questions. A special model was devised from Guilford's factor analytic studies to categorize teacher questions. In addition, the effectiveness of an experimental educational program in inducing elementary teachers to employ a process approach to teaching intellectual skills was assessed. The results revealed the trained coders could use the model with reliability. It was found that elementary teachers placed an inordinate amount of emphasis on factual knowledge questions thereby precluding the teaching of other intellectual operations.

The experimental educational program significantly altered the question asking behavior of teachers by reducing the incidence of cognition and memory questions and by increasing the use of perception questions. These findings were interpreted as being indicative of significant change in teacher question asking behavior from a content mastery approach to an intellectual process approach. The results were discussed with regard to motivation of disadvantaged children.

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